DIRECT TESTIMONY OF
BRADLEY T. PERRICELLI
ON BEHALF OF
DOMINION ENERGY SOUTH CAROLINA, INC.
DOCKET NO. 2023-9-E

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Bradley Perricelli and my business address is 220 Operation Way, Cayce, South Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by Dominion Energy South Carolina, Inc. ("DESC" or the "Company") as the Senior Energy Market Analyst.

Q. PLEASE DESCRIBE YOUR DUTIES RELATED TO RESOURCE PLANNING IN YOUR CURRENT POSITION.

A. I am responsible for developing and improving accuracy of predictive models for electric use within the DESC service territory. This includes total sales as well as the system peak demand. These are direct inputs for the company's Integrated Resource Plan ("IRP"), and the company topline budget estimates. I also participate in IRP and Energy Efficiency Advisory Groups ("EEAG" or "Advisory Group") with regulatory staff and other interested stakeholders. This includes communicating company standing on regulatory items, understanding stakeholder concerns, and responding in a manner than can help improve efficiencies and collaboration for upcoming hearings and filings.

Q. DESCRIBE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL EXPERIENCE.

A. I graduated from The Citadel with a Bachelor of Science Degree in Biology. I also hold a Master of Business Administration from Webster University and a Master of Applied Statistics from the University of South Carolina.

I joined South Carolina Electric and Gas ("SCE&G") as a Performance Improvement Specialist in 2012 where I led the site-wide analytics process for VC Summer Nuclear Station. In 2017, I served briefly as the Corrective Action Program Supervisor for SCE&G where I ensured compliance with the Nuclear Regulatory Commission regulations in the process to identify, evaluate, and resolve technical and process issues. I joined DESC in September 2017 before the merger with SCANA and became a Senior Analyst primarily working on electric and gas rates. Since 2021, I have served in my current role as Senior Energy Market Analyst.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE PUBLIC SERVICE COMMISSION OF SOUTH CAROLINA ("COMMISSION")?

A. No.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to discuss the reference load forecast, the peak demand forecast, and the forecast scenarios included in DESC's 2023

Integrated Resource Plan ("IRP"), specifically the electric vehicles ("EV") component.

DESC'S ENERGY FORECAST

Q. WHAT IS THE FORECASTING PROCESS USED AT DESC?

A. Every summer the forecast of customers, sales, peak demands, and revenue is made essentially from scratch. Datasets are updated with the latest information through the beginning of the summer and the statistical models are re-run and checked for adequacy, with changes being made where improvements in the forecast can be identified. Additionally, the Large Customer Department and the Economic Development Department are asked to provide input regarding existing customer expansions or contractions and the possibility of large new customers being added or leaving the system. The forecast is divided into two parts: the short run and the long run. The short run forecast is made by month for two years. The revenue projections derived from the short run forecast are critical to the Company's budgeting process and short run operations. The short run forecast is made at the rate level since the revenue projections need to be made. The long run forecast is made by year for the eighteen years beyond the two years covered in the short run. The long run forecast is critical to the long-range planning of the Company.

Q. CAN YOU PROVIDE SOME DETAILS ON THE COMPONENTS OF DESC'S FORECASTING METHODOLOGY?

A. Yes. Exhibit No. __(BTP-1) provides a description of the components used in both the short run and the long run models. As mentioned, the short run models involve many more components than the long run largely because of the need to incorporate rate level detail. For example, sales under the standard Rate 8 residential tariff, are broken down into single-family, multi-family and mobile home categories and are further classified by a statistical estimate of weather sensitivity. The number of customers for each of these categories is projected separately. This translates into about 18 different statistical models just to forecast Rate 8 sales. Similar categories are formed for the other major residential rates *i.e.,* 1, 2 and 6. In the industrial class there are about 30 large customers who comprise about 70% of industrial sales. Sales to each of these customers are projected at the individual customer level.

Q. IS THE NATURE OF THE LONG RUN STATISTICAL MODELS DIFFERENT FROM THE SHORT RUN MODELS?

A. Yes. All the long run models project rates of growth for the different components of the forecast. Sales projected for the second year of the short run are summarized into over 30 separate components and these become the base year for the long run forecast. Each of these components has an associated long run statistical model that projects its growth path over the following eighteen years. While the long run forecast is less granular than the short run, it is still quite detailed, having more than 30 individual components. For example, in the residential class while the rate detail is collapsed, the breakout by single-family home, multi-family home and mobile home is retained as well as the weather sensitive average use models with the number of customers and the average use per customer projected separately. The long run industrial forecast of growth rates is not made for individual customers but rather at the 2-digit Standard Industrial Classification ("SIC") level.

Q. HOW DOES THE COMPANY VERIFY THAT THE ENERGY FORECAST IS REASONABLE?

A. One way to gauge the reasonableness of the forecast is to compare the forecast with actual results and see if the differences can be explained by known factors such as COVID-19, recessions, changes in energy technology, customer self-generation or other factors. For example, Table 1 below compares the projected growth over the next five years to that of the last five years.

Table 1. Comparison of Projected Growth over the Next Five Years to Last Five Years

		Sales Data				% Growth	
Class	**Item**	**2017**	**2022**	**2023**	**2028**	**History**	**Forecast**
Residential	Nbr Customers	615,095	669,525	678,117	721,480	1.7	1.2
	kWh per Customer	13,175	12,593	12,501	12,323	-0.9	-0.3
	Total GWh Sales	8,104	8,431	8,477	8,891	0.8	1.0
Commercial	Nbr Customers	95,579	102,202	102,783	107,065	1.3	0.8
	kWh per Customer	76,774	70,057	71,364	70,275	-1.8	-0.3
	Total GWh Sales	7,338	7,160	7,335	7,524	-0.5	0.5
Industrial	Total GWh Sales	6,203	5,527	5,551	5,801	-2.3	0.9
All Sales	Total GWh Sales	23,152	22,498	22,809	22,873	-0.6	0.1

In the case of the residential class, "Total Gigawatt Hour ("GWh") Sales" is projected to grow at essentially the same rate in the future as it has in the past. This suggests that the forecast in this case is reasonably consistent with past observations and indicative of a steadily growing residential customer base. The commercial class showed a slight decrease over the previous five years, and we are projecting a slight increase over the next five years. This is reasonable since this class experienced the greatest negative impact during the COVID-19 lockdowns in the 2019 through 2021 timeframe. Most daily activities appear to be returning to a more similar state as before the pandemic for this class, so it is reasonable to project a very modest rate of growth. The growth in industrial sales shows the biggest difference between forecast and history. This disparity can be explained. Over the last five years, two large customers became co-generators resulting in the loss of approximately 700 GWh in sales which accounts for the negative growth rate. We also know that industrial presence in our service territory is currently stable and has growing sales. There is no reason to assume that will not be the case going forward especially when considering recent economic development announcements in South Carolina.

Table 2 below compares the growth rates projected over the next 15 years to that experienced over the past 15 years.

Table 2. Comparison of Projected Growth over 15 Years

		Sales Data				% Growth	
Class	**Item**	**2008**	**2022**	**2023**	**2037**	**History**	**Forecast**
Residential	Nbr Customers	553,548	669,525	678,117	794,465	1.4	1.1
	kWh per Customer	14,362	12,593	12,501	13,116	-0.9	0.3
	Total GWh Sales	7,950	8,431	8,477	10,420	0.4	1.5
Commercial	Nbr Customers	88,698	102,202	102,783	115,346	1.0	0.8
	kWh per Customer	84,365	70,057	71,364	74,922	-1.3	0.3
	Total GWh Sales	7,483	7,160	7,335	8,642	-0.3	1.2
Industrial	Total GWh Sales	6,143	5,527	5,551	6,237	-0.8	0.8
All Sales	Total GWh Sales	23,615	22,498	22,809	25,936	-0.3	0.9

The residential and commercial sales are expected to accelerate in the future compared to the historical observations. A slight deceleration is projected in customer growth for both classes. However, this is more than offset by a reversing trend of increasing average use per customer. This is reasonable considering the population growth in the service territory as well as the impact of EVs. Industrial sales are projected to grow slightly compared to the historical negative growth. This is understandable when again considering the recent loss of sales to cogeneration and lingering effects from the Great Recession after 2008.

<u>DESC'S PEAK DEMAND FORECAST</u>

Q. WHAT ARE THE PRINCIPAL RESULTS OF DESC'S PEAK DEMAND FORECAST STUDY?

A. The reference load forecast used in this 2023 IRP incorporates the Company's 2023 annual Base Load Forecast of customers' future energy and demand needs for the planning horizon and reflects the updated Guidehouse forecast for expansion in demand for electric vehicles. The reference load anticipates a significant one-time reduction in peak electric demand in 2024, relative to 2023, due to the expected termination of the power supply agreement with the City of Orangeburg, South Carolina. Summer and winter peak demands then continue to grow at a relatively steady rate beginning in 2024. The compound average rate of growth in summer and winter demand over the planning horizon are 0.9% and 0.6% respectively.

These peak demands reflect average weather observed during previous peaks and do not show the impact of the utility-scale solar contribution, interruptible programs, or standby-generators to meeting summer or winter peak or required reserve margins. These adjustments are made later in the generation planning process. Also, these growth rates also do not include the potential demand reductions due to new demand response ("DR") programs, which are treated as generation resources in the PLEXOS model. Table 3 shows the forecasted peaks on a calendar basis.

Table 3. 2023 Annual Energy and Peak Forecast

Annual Energy and Peak Forecast			
		Peak Demand	
Year	Sales GWh	Summer MW	Winter MW
2023	23,941	4,921	4,902
2024	23,247	4,791	4,775
2025	23,359	4,825	4,813
2026	23,570	4,867	4,851
2027	23,790	4,915	4,891
2028	24,017	4,966	4,931
2029	24,287	5,021	4,971
2030	24,584	5,079	5,009
2031	24,890	5,142	5,048
2032	25,248	5,210	5,091
2033	25,613	5,281	5,133
2034	25,988	5,356	5,179
2035	26,370	5,433	5,228
2036	26,740	5,509	5,274
2037	27,157	5,595	5,332

For the years 2025 and later, the current peak demand forecast is generally higher than the similar forecast for 2022. This is due to higher assumed penetrations of EVs, lower assumed levels of demand reductions achievable through Company-sponsored demand side management ("DSM") programs, and higher rates of demand growth for residential customers. These increases are offset in part by lower assumed rates of demand for commercial and industrial customers.

Q. WHAT ARE THE CATEGORIES THAT YOU USE FOR CUSTOMER CLASSES?

A. The rows listed with classes of customer equal to 10.0, 20.0, 30.0, 60.0, 70.0 and 92.0 represent calculations of the base peak demand forecast for the residential, commercial, industrial, public street lighting, other public authorities, and municipal classes of customers, respectively. The other rows represent adjustments to this base forecast. The following table explains what they represent.

Table 4. Adjustment Definitions

Category	Description
10.2 Res.Adj.	Residential adjustments for EVs, SEER, Lighting, Water Heating, Energy Efficiency, and Net Metering
20.2 Com.Adj.	Commercial adjustments for EVs, Lighting, Energy Efficiency, and Net Metering
30.1 Ind.DR	Industrial interruptible load
30.2 Ind.Adj.	Industrial adjustments for Net Metering
98.1 CoUse	Effect of Company's Use of power
98.5 DR	Demand response to include interruptible loads and standby generation

Q. HOW DOES DESC FORECAST ITS SEASONAL PEAK DEMANDS?

A. The basic methodology uses the customer and energy sales forecast as the drivers for growth and uses the load characteristics of each customer class captured in the Company's Load Research Program to develop the resulting peak demand. After this base level of demand is calculated, adjustments are made to the forecast to account for the incremental impacts of energy efficiency ("EE") (both from Company DSM programs and federal and other mandates), EVs, and incremental net energy metering on the system. Table 5 below shows the components and the process to develop the summer peak forecast for 2023.

Table 5. Components of Summer Peak Forecast

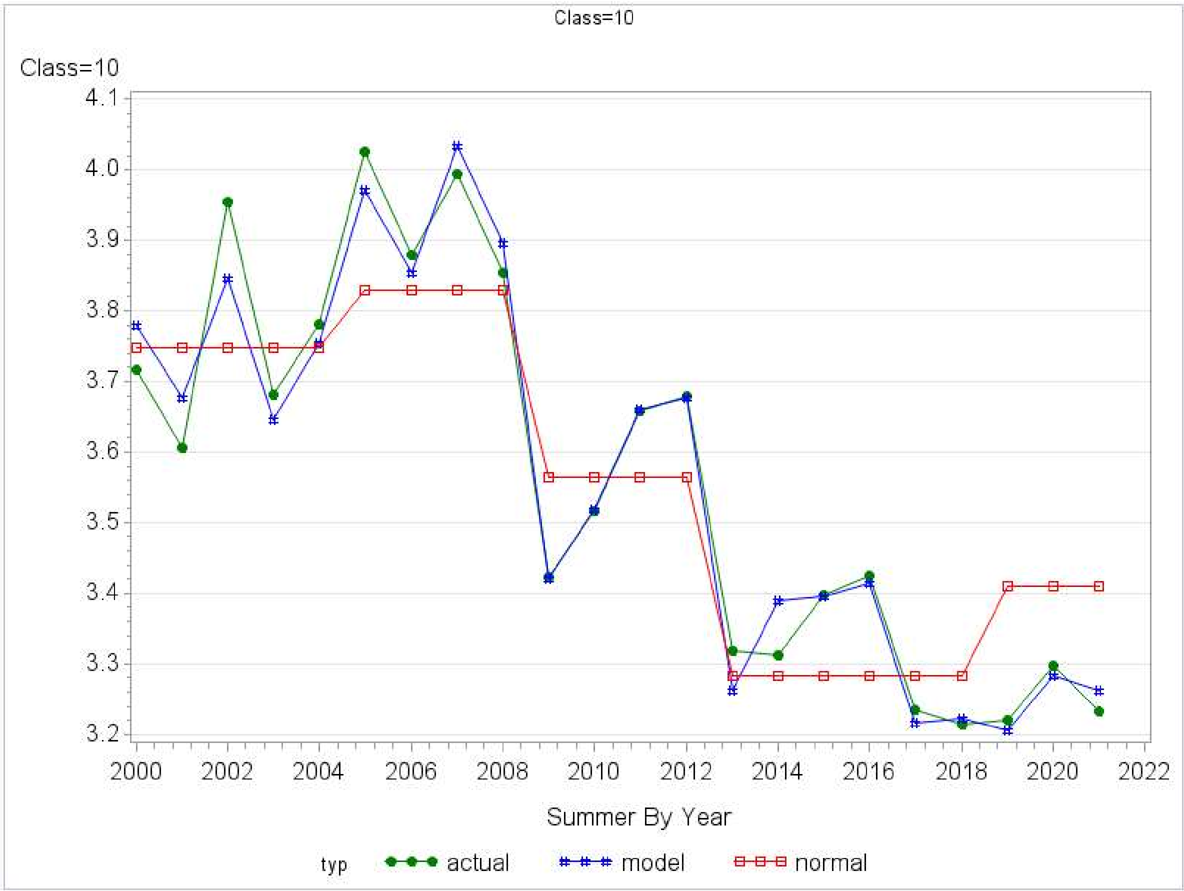
			Energy Forecast		Summer Peak		
Year	Class	Desc.	Customer	GWH Sales	kW Per	Factor	Peak Demand
2023	10.0	Res	678,117	.	3.400	1.0064	2,320
	10.2	Res.Adj	.	.	.	.	-40
	20.0	Com	102,783	.	14.890	1.0064	1,540
	20.2	Com.Adj	.	.	.	.	-14
	30.0	Ind	.	5551.0	0.980	1.0064	625
	30.1	Ind.DR	.	.	.	.	204
	30.2	Ind.Adj	.	.	.	.	-7
	60.0	PSL	.	148.5	0.100	1.0064	2
	70.0	OPA	.	512.0	1.480	1.0064	87
	92.0	Muni	.	859.0	1.740	1.0064	172
	98.1	CoUse	.	.	.	.	32
	98.5	DR	.	.	.	.	-241
2023			.	.	.	.	4,680

The 4-hour factor in the table, *i.e.*, 1.0064, applied in the summer season converts the forecast for the 4-hour band of hours, *i.e.*, 2 p.m. to 6 p.m., to a one-hour basis. The winter peak does not need to be converted since it is projected on a one-hour basis. The calculation for the residential and commercial classes is straightforward. For example, in the case of the residential 2023 summer, the peak demand is 2,320 Megawatts ("MW") and the calculation is:

678,117 * 3.400 *1.0064 /1000 = 2,320 MW

The kW per customer value of 3.400 is derived from DESC's Load Research Program and is the weather normalized average kW per customer value taken over the last few years. The following table shows the results of a statistical regression analysis which is its source.

Table 6. Statistical Regression Analysis



The green line in the graph is actual peak kW per customer on average, and the blue line is the peak kW per customer on average that would have been predicted based on the actual weather at peak. These two lines are very close, with nearly identical data points in most years. This shows that the load forecasting model is highly accurate and the variation between actual and forecasted peak kW per customer on average is a function of the unpredictability of weather.

The red straight line in the graph is the weather normalized average kW per customer which is the basis for the peak kW per customer forecast. The declines in this number represent how the forecast captures the changes in usage patterns due to increased energy efficiency and changes in customer behavior.

For the industrial class, the number of hours in the year comes into play. For example, in the case of the industrial 2023 summer, the calculation is:

$$(5{,}551/ (8{,}760/1{,}000)) * 0.98 * 1.0064 = 625 \text{ MW}.$$

It may be worth noting that the kW per kilowatt hour ("kWh") load characteristic can be referred to as the demand ratio and is equal to the reciprocal of the load factor.

The following table shows the development of the 2023 winter peak, that is, the peak occurring in the 2023/2024 winter season.

Table 7. Components of Winter Peak Forecast

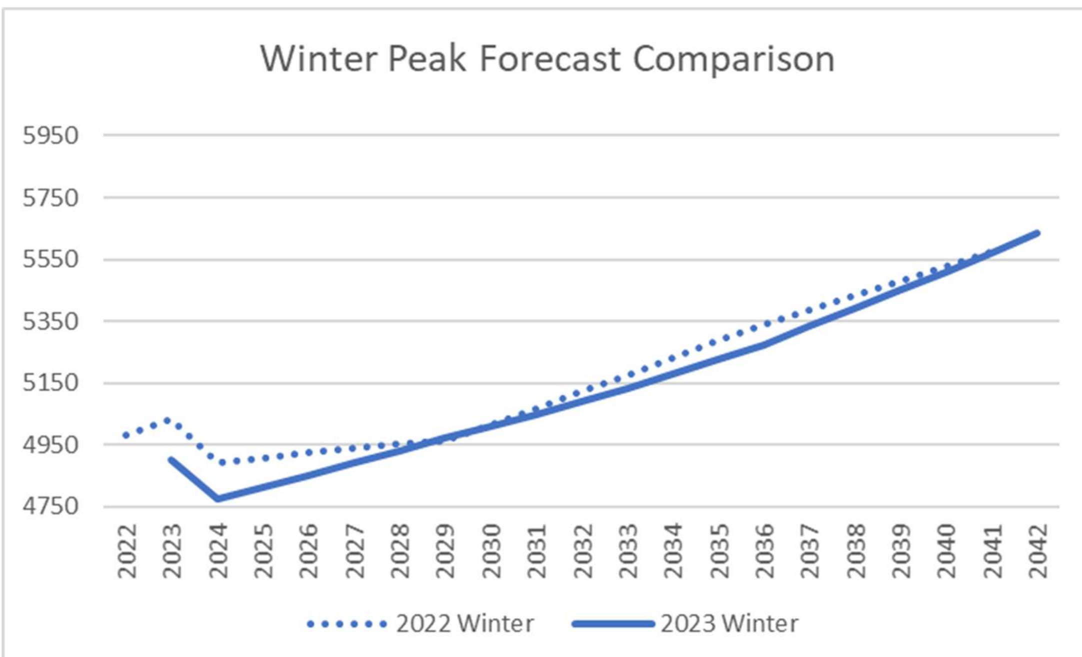
				Energy Forecast		Winter Peak	
WYear	Year	Class	Desc.	Customer	GWH Sales	kW Per	Peak Demand
2023	2024	10.0	Res	687,320	.	3.770	2,591
		10.2	Res.Adj	.	.	.	-18
		20.0	Com	103,148	.	13.600	1,403
		20.2	Com.Adj	.	.	.	-7
		30.0	Ind	.	5603.0	0.770	493
		30.1	Ind.DR	.	.	.	198
		30.2	Ind.Adj	.	.	.	0
		60.0	PSL	.	147.9	0.140	2
		70.0	OPA	.	512.0	1.200	70
		92.0	Muni	.	58.0	1.720	11
		98.1	CoUse	.	.	.	32
		98.5	DR	.	.	.	-211
2023	2024			.	.	.	4,564

The winter peak demands are calculated in the same way as the summer except there is no need for the 1.0064 4-hour conversion factor.

Q. WHAT IS THE CURRENT WINTER PEAK FORECAST AND HOW HAS IT CHANGED SINCE THE 2022 FORECAST?

A. The 2023 forecasts of winter peak demands are somewhat lower but generally consistent with those from 2022. This is a result of the fact that most EV charging is anticipated to take place outside of peak demand periods in the winter. The table below shows a comparison of these forecasts.

Table 8. Winter Peak Forecast Comparison (MW)



Q. WHAT IS THE CURRENT SUMMER PEAK FORECAST AND HOW HAS IT CHANGED SINCE THE 2022 FORECAST?

A. The summer peak forecast has changed more than the winter peak, and this is primarily due to increases in forecasted EV demand. Table 9 shows a comparison of these two forecasts. Other factors that contributed to an overall increase are the reduction in the 2023 DSM Potential Study results which have a net increase in peak demand and increases in weather normalized demand from the residential class. These differences between the previous and current forecasted peak demand in 2037 are quantified in Table 10.

Table 9. Summer Peak Forecast Comparison (MW)

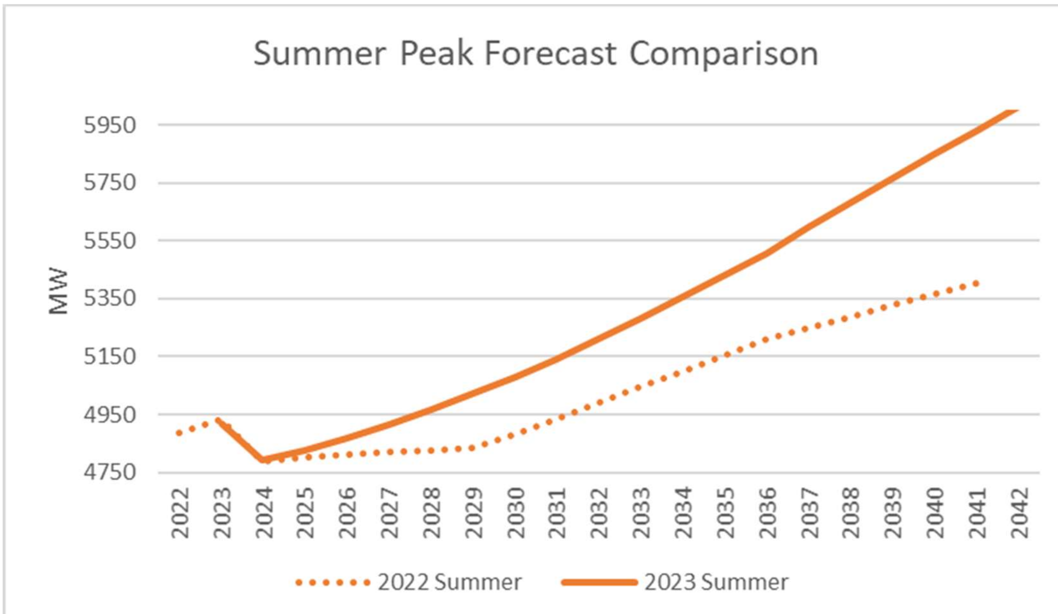
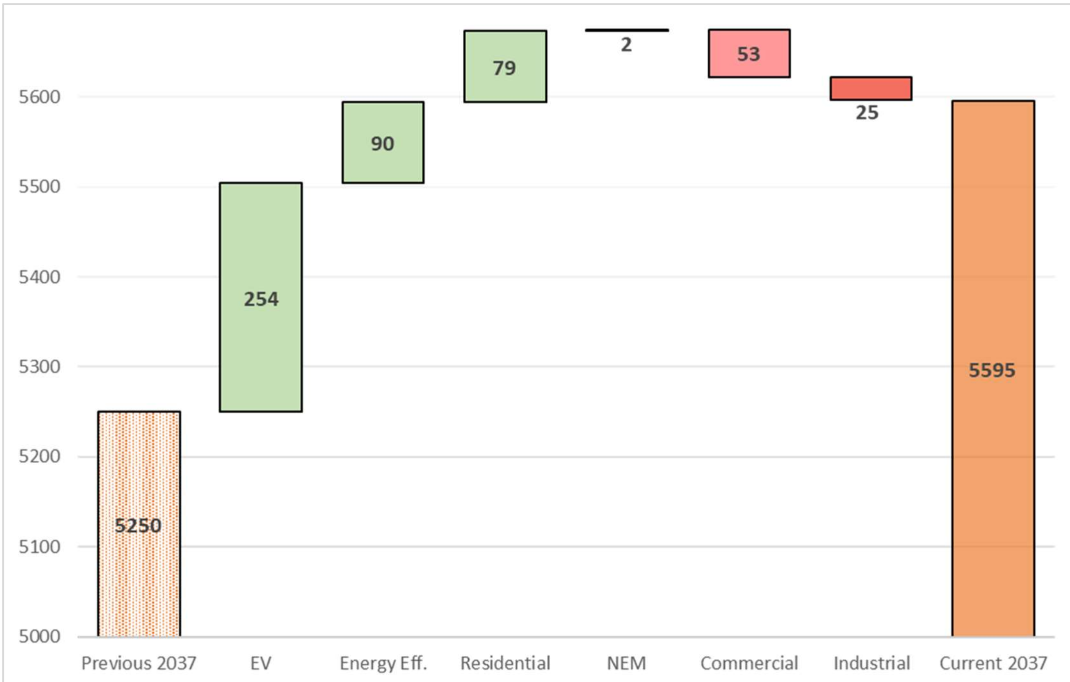


Table 10. The 2022 and 2023 Summer Peak Demand Forecasts for 2037 Compared



DESC'S FORECAST SCENARIOS

Q. WHY ARE FORECAST SCENARIOS INCLUDED IN THE 2023 IRP?

A. One of the requirements legislated in the South Carolina Act No. 62 of 2019 ("Act No. 62") for IRPs was to include "a long-term forecast of the utility's sales and peak demand under various reasonable scenarios." In response, DESC included three scenarios that presented risks to the baseline forecast of sales and peak demands.

Q. WHAT FORECAST SCENARIOS WERE CONSIDERED?

A. There were three scenarios presented: a reference load forecast which incorporates the Company's 2023 Base Load Forecast of customer's future energy and demand needs across the planning horizon and reflects the updated forecast for expansion in demand for electric vehicles ("EV") and base DSM assumptions. DESC has also created a high and low load growth rate scenario to assess its generation planning under alternative market scenarios.

Q. EXPLAIN THE HIGH AND LOW LOAD GROWTH RATE SCENARIOS.

A. Historically, as measured over fifteen-year increments from 2001 to 2021, the compound annual growth in demand has varied between 0.778% and minus 0.372%, against a compound annual growth rate of 0.317% during that period. An assumed variation of ± 0.5% from the forecasted growth rate of 0.9% reasonably captures the range of expected variation in growth rates going forward as measured by historical data.

Given that the current reference forecast is for load growth of 0.9%, an increase or decrease of 0.5% represents a variation of more than 50% from the expected rate of growth. Of course, these variations in load expectations are compounded annually in a straight-line fashion over the course of the planning horizon and without allowance for low growth rates in one period being offset by high growth rates in another, or vice versa.

Over 20 years, these high and low load growth assumptions create a band around the reference electrical demand forecast of 482 MW on the low case and 524 MW on the high case, or 8.6% and 9.3%, respectively, of the reference forecast of 5,633 MW in 2042. The band around the reference energy forecast is between 2,342 GWh on the low load case and 2,895 GWh on the high load case, or 8.0% and 9.9% of the reference forecast, respectively. This is a reasonably broad band.

The following figures show the variation in the low, reference and high demand forecasts and energy forecasts.

Table 11. Low, Reference and High Demand Forecasts

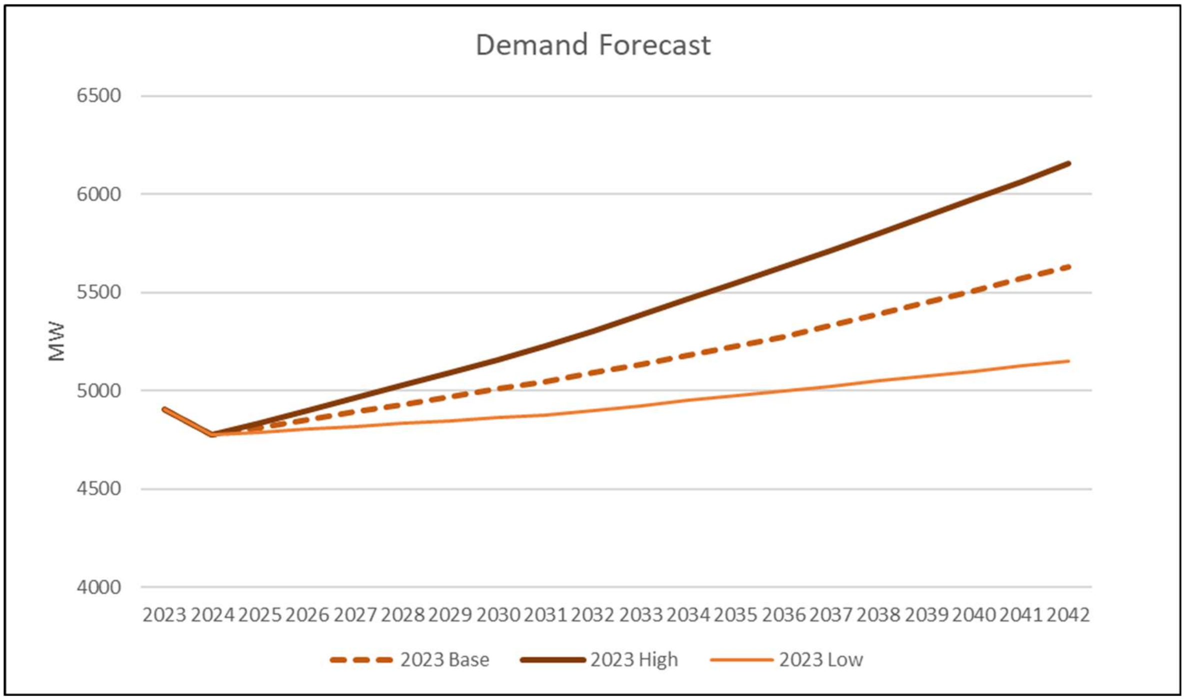
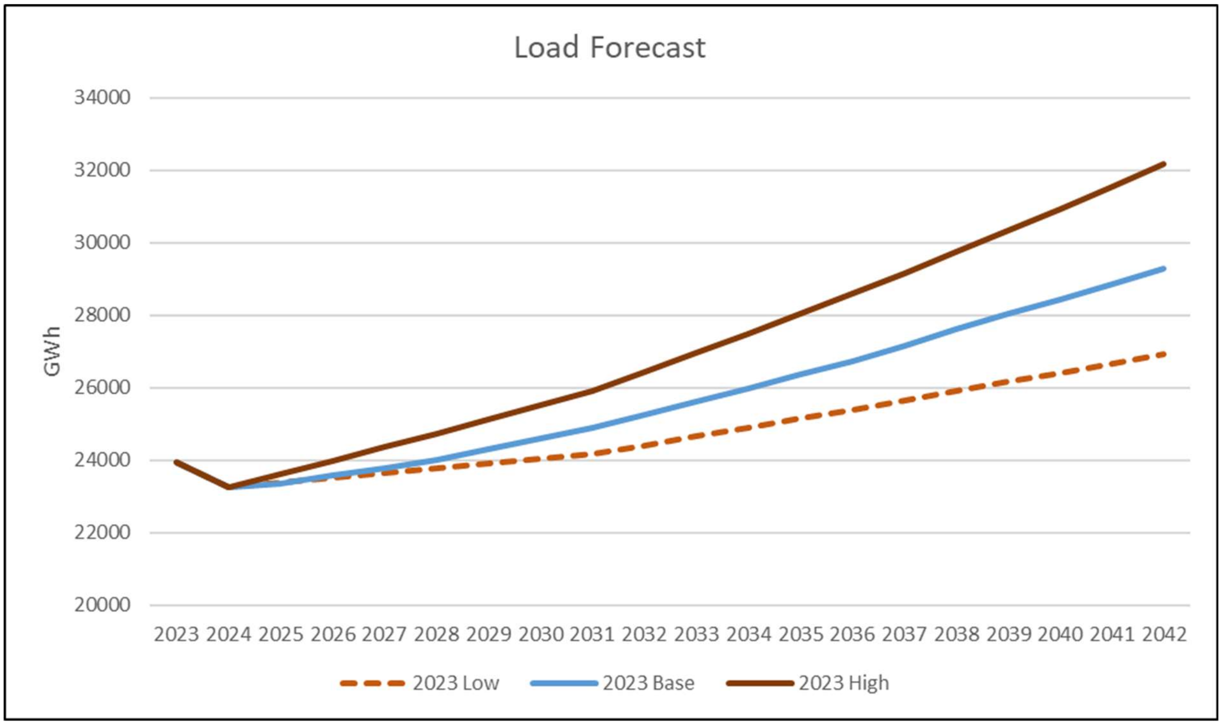


Table 12. Low, Reference and High Energy Forecasts



Q. EXPLAIN HOW WHOLESALE SALES CONTRIBUTE TO THE LOAD GROWTH FORECAST.

A. Wholesale energy sales currently represent about 3.7% of the Company's total sales. Wholesale customers are served by the Company through negotiated long-term power supply contracts. For periods of time beyond the terms of the existing long-term power supply contracts, the Company must compete with other power suppliers for the wholesale customers' business. The Company's largest wholesale customer currently is the City of Orangeburg, which has indicated that it will leave DESC's system by January 1, 2024, after which wholesale sales will represent approximately 0.3% of DESC's total sales.

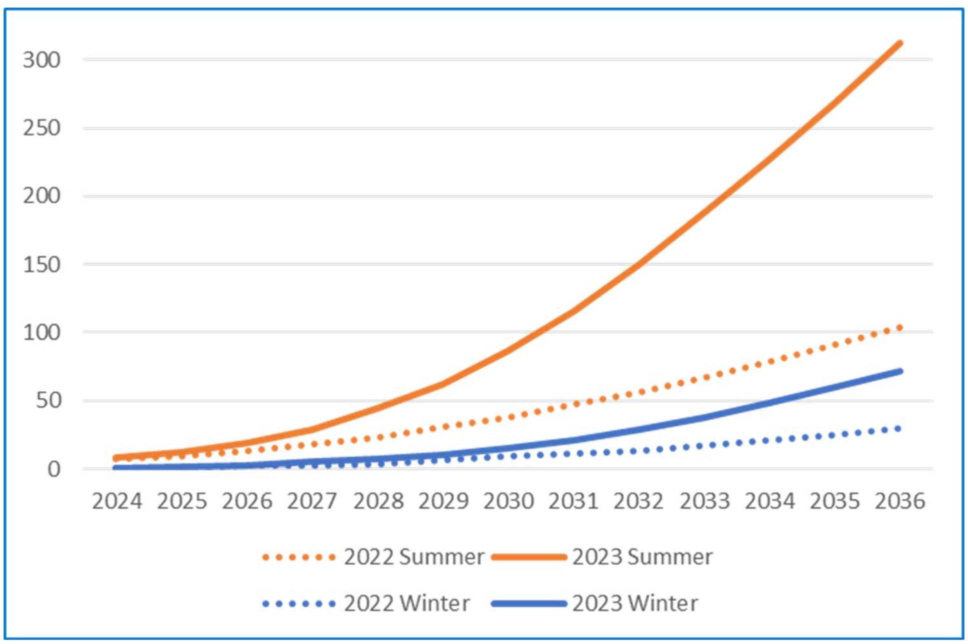
Q. EXPLAIN HOW THE EV FORECAST IMPACTS THE LOAD GROWTH FORECAST FOR THIS IRP.

A. Electric vehicle penetration is expected to grow significantly during the planning period due in part to accelerating demand, increased model availability, and strong political, environmental, and regulatory support. Three states have announced new internal combustion engine ("ICE") vehicle bans by 2035, and the Company anticipates that more states will adopt similar policies in the future. In response, car manufacturers are switching their design and production focus from ICE vehicles to EVs, and this change will rapidly drive EV adoption nationwide. Some automakers have announced goals to reach 40-50% EV model sales by 2030. Additionally, federal vehicle and infrastructure incentives in the IRA and IIJA (i.e., tax credits, high speed charging stations, electric school and transit buses) will boost EV sales, increase customer demand, and decrease "range anxiety" hurdles. With an increase in EV sales, at home vehicle charging by customers will be a driver of EV load growth and annual energy consumption. It is expected that these national developments will have an impact on the DESC service territory independent of future policies or legislation in South Carolina.

DESC retained the Guidehouse consulting firm to conduct an EV Adoption Study to evaluate the anticipated penetration of electric vehicles in DESC's service territory over a fifteen-year period and forecast the expected growth in customer demands as a result. Details on the EV Adoption Study are provided in more detail in the testimony of Mr. Scott Robinson.

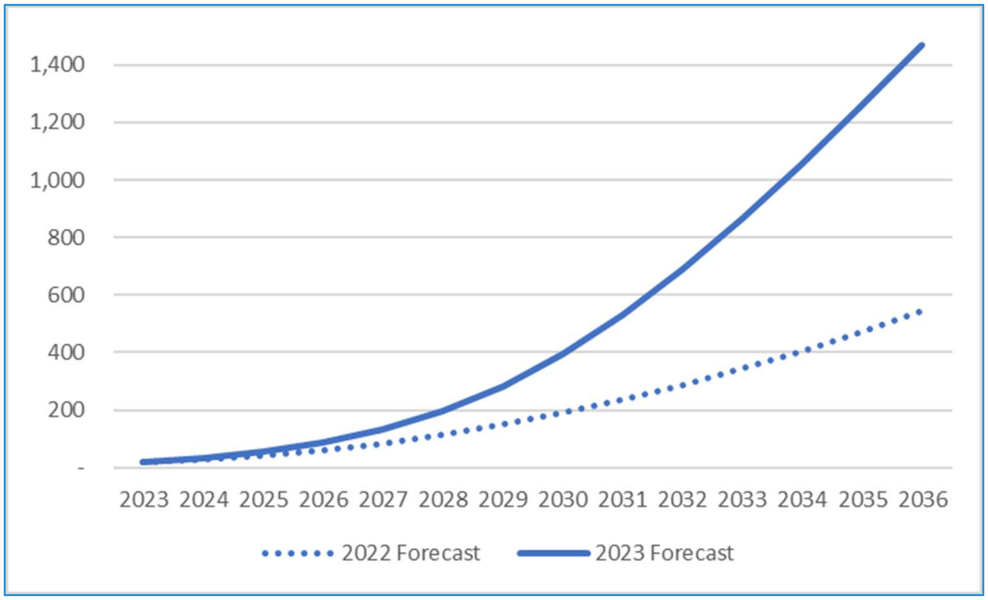
Specifically, Guidehouse determined that EV adoption will have its greatest impact on summer peak load because EV owners are expected to be charging their vehicles at the end of the day when summer peaks occur. In contrast, the winter peaks happen in the early morning hours after most EV charging will be complete, so EV contribution to winter coincident peak is reduced. In 2037, the estimated contribution to summer peak from EV charging is approximately 358 MW or 6.4% of peak summer demand.

Table 13. Estimated Contribution of EV Charging to Coincident Summer and Winter Peak (2022 and 2023 Forecasts Compared)



Guidehouse also determined that the EV contribution to annual energy consumption would reach 337 GWh by 2030 and 4,409 GWh by 2050, the latter is approximately 12% of the total energy consumption in 2050 under the Reference Build Plan and Reference Market Scenario.

Table 14. Estimated Contribution of EV Charging to Annual Energy (GWh) Consumption (2022 and 2023 Forecasts Compared)



The updated forecasts of EV contributions to future energy demands are included in the 2023 load forecast.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes